

2.4 Aviation Security Program Area Description

Mission

The FAA Aviation Security Research and Development (R&D) Division is the lead establishment within the FAA responsible for R&D programs related to civil aviation security. The division's mission is to perform research and development to help prevent civil aviation security incidents through programs that accelerate and expand R&D and support the deployment of advanced technologies. Products of the division lead to equipment and methods designed to counteract criminal and terrorist attacks against civil aviation. This mission provides assistance in anticipating future threats to civil aviation and emphasizes the need to rely less on human intervention for detection and deterrence. Well integrated, automated aviation security systems that leverage benefits from a variety of technologies will produce better operational performance.

Intended Outcomes

The main goal for the Aviation Security R&D Program is to deter or detect criminal and terrorist threats to civil aviation and mitigate the effects of incidents that occur. This promotes public confidence and has direct economic benefit to the aviation industry. The increasing extent and sophistication of terrorism make it necessary for the FAA to identify and develop practical, effective technologies applicable to aviation security systems. These systems must be comprehensive and extensive enough to address all potential aviation security vulnerabilities at the airport, in loading and servicing the aircraft itself, and at air traffic control facilities.

The Aviation Security Program is conducting extensive R&D on the detection of explosives, weapons, and other more sophisticated threats to prevent their placement on board aircraft. The Aviation Security R&D Program focuses on automated aviation security systems and screening protocols that enable the highest throughput and at both the least intrusive and most effective, thus minimizing passenger delays and inconvenience. Aviation Security also conducts R&D to identify methods to harden the aircraft to mitigate the damaging effects of explosives, weapons, surface to air missiles, and electromagnetic interference.

Program Area Outputs

The FAA, through the Aviation Security R&D Program, promotes the development of technologically improved products and procedures in explosives detection, aircraft hardening, airport security, and human factors. Program outputs include:

- Developing a structured, total airport security system definition and concept of operations for distribution to FAA R&D security planners.
- Developing R&D test protocols and performance criteria to aid in the operational deployment of improved aviation security systems.
- Providing information and data defining standardized methods of security screener selection, training and performance evaluation.
- Testing explosives resistant baggage containers.
- Exploring other blast mitigation techniques to ensure that potentially catastrophic criminal and terrorist acts do not result in the loss of lives and aircraft.

Aviation Security R&D products are systems, devices, technologies, specifications, analysis tools, technology integration plans and procedures. These products are for use by airports, air carriers, airframe manufacturers, and screening companies to improve civil aviation security.

Program Area Structure

The Aviation Security R&D Program accomplishes its mission by dividing the program into four interrelated areas: Explosives and Weapons Detection, Aircraft Hardening, Human Factors, and Airport Security Technology Integration. Each program area makes a different but significant contribution toward achieving the goal of a safe and secure air transportation system.

The focus of the *Explosives and Weapons Detection* program area is to develop new, or to improve existing methods and technologies to detect explosives and weapons in checked and carry-on baggage, on passengers, or in air cargo. The weapons detection program promotes pre-board screening to prevent the armed takeover of air-

craft. This program area assists with development of standards and specifications for test and certification or approval of detection equipment.

The major purpose of the *Aircraft Hardening* program area is to conduct research to increase civil aircraft survivability in the event of an in-flight explosion. Additionally, this program seeks to identify the type and minimum weight of an explosive that could cause catastrophic damage or aircraft loss. The program also develops methods to protect aircraft avionics and systems from the damaging effects of false electromagnetic or high-energy signal interference.

The objective of the *Aviation Security Human Factors* program area is to improve the human element of the aviation security system. The program develops methods to select the screener as well as measure and improve screener performance levels, especially important as aviation security components merge into future integrated systems. Emphasis is placed on the capabilities and constraints of manpower: training, human factors engineering, and the health and safety aspects of human performance.

The *Airport Security Technology Integration* program area focuses on technologies that prevent unauthorized access to aircraft and airport facilities. Major emphasis is on recommending future system designs and concepts of operation while evaluating and promoting operational readiness and suitability. Technology products include analytical models, state-of-the-art perimeter control, and passenger/baggage matching technologies that prevent unaccompanied baggage from being loaded on board aircraft. This program develops simulation and modeling tools. One set of tools performs airport security (vulnerability, risk and blast effects) analysis while the other set is used to seamlessly integrate, improve, and reduce operating costs for technologies developed by other programs in the Aviation Security R&D Program area.

The FAA Aviation Security R&D Program conducts six R&D projects to achieve the goals of the four Aviation Security R&D budget line items. The three R&D projects, titled Checked Baggage, Cargo/Mail, and Checkpoint support the Explosives and Weapons Detection budget line item. The other three areas, Aircraft Hardening, Human

Factors, and Airport Security Technology Integration, each have a dedicated budget line. Any one program will not solve all the issues. Technology development has not reached a point where it can operate autonomously. The Aviation Security R&D Program embraces a systems-oriented approach that balances the application of people, procedures, and technology to each threat and vulnerability.

Customer/Stakeholder Involvement

- The Aviation Security Improvement Act of 1990 (Public Law 101-604, codified as 49 U.S.C. 44912) provides direction for the FAA's System Security Technology Program. The FAA's Office of Civil Aviation Security Policy and Planning imposes research requirements in the following areas:
- Checkpoint
- Checked Baggage
- Mail and Cargo
- Chemical and Biological Agents
- Explosives Detection Canines
- Human Factors
- Airport Security Technology Integration
- Aircraft Hardening
- Independent Test and Evaluation

In 1996, the White House Commission on Aviation Safety and Security strongly emphasized continued R&D in all program areas, and recommended the deployment of existing explosives detection technology. Congress funded further R&D and the FAA's purchase and installation of explosives detection systems (EDS) and explosives detection devices (EDD). The FAA Security Equipment Integrated Product Team (SEIPT) is purchasing and deploying advanced security equipment at various airports throughout the United States.

Other stakeholders include the National Academy of Sciences, the Aviation Security R&D Scientific Advisory Panel, the R&D Advisory Council, and the Aviation Security Advisory Committee, which hold frequent reviews of R&D plans and results. Efforts also include interagency work with the Technical Support Working Group. Their recommendations include changes in the direction or emphasis of research plans.

Accomplishments

The FAA Aviation Security R&D Program has been in effect since 1974. Note the following significant accomplishments:

- In November 1994, certified the InVision CTX 5000 and established a demonstration effort that delivered four certified CTX 5000 EDS to air carriers for operational testing. FAA certification criteria examines three performance areas including detection, false alarms and throughput requirements. The CTX 5000 conducts a pre-scan and produces cross sectional slices in the areas of interest. Data collection and analysis have taken place at airports in San Francisco, Atlanta, and Manila.
- In October 1998, certified the L-3 Communications eXaminer 3DX6000 EDS. The eXaminer 3DX6000 scans and analyzes the entire bag using a cone beam at a rate of about five seconds per bag and renders a full 3D image. This is the second company to meet the FAA certification criteria for explosives detection.
- In April 1999, certified the InVision CTX 9000 DSi Galileo.
- The Aviation Security R&D Program is developing a low cost Explosive Detection System (ARGUS system consisting of multiple units) for use at smaller airports. Competitive grant solicitations are scheduled for late FY 99.
- The Aviation Security R&D Program staff provided critical input for the SEIPT's effective deployment, which began in January 1997. To date 79 CTX 5500 EDS have been installed in airports.
- The Aviation Security R&D Program staff provided support for the deployment of over 470 explosives trace detection devices to U.S. airports with more scheduled in FY 2000.
- Trace detection prototypes for screening personnel using devices such as portals and document scanners are being developed and evaluated both in the laboratory and in airport environments.
- The Aviation Security R&D Program conducted explosives testing on various aircraft to provide data to validate and refine explosives detection criteria. These tests included a Boeing 747 test performed jointly with the United Kingdom, a Lockheed L1011 test performed with the manufacturing community, and vulnerability testing on DC-9 and 727 aircraft.
- The Aviation Security R&D Program supported the 1996 Olympics in Atlanta by deploying explosives trace detection devices and the CTX 5000 system. Aviation Security is also supporting the 2000 Olympics in Australia.
- The Aviation Security R&D Program is conducting a demonstration effort on hardened LD-3 baggage containers with three commercial air carriers.
- In August 1999, Aviation Security R&D Program completed a MANPAD study on the effectiveness of Infrared systems against external aircraft lighting.
- The Aviation Security R&D Program, in cooperation with U.S. Air Force Phillips Laboratory, will complete in FY99 a study on the vulnerability of commercial aircraft to High Powered Microwave and other directed energy weapons.
- The Aviation Security R&D Program established criteria to limit cross-contamination of explosives used to train and certify explosives detection canine teams.
- As part of the goal to improve screener selection and performance, Aviation Security R&D Program is developing a Screener Readiness Test. This test, owned by the government, will determine when the screener has received sufficient initial training. Data to determine the baseline for this study is being collected by Delta in Atlanta, Northwest in Detroit, and Alaska Airlines in Seattle.
- The Aviation Security R&D Program performed an international study of radio frequency identification tags. This technology will make positive passenger baggage matching (PPBM) cost effective and operationally feasible when deployed in the field.
- The Aviation Security R&D Program completed an industry-wide, economic analysis

on the costs of PPBM, and provided the results to both industry and FAA rule making teams.

- The Aviation Security R&D Program completed the Blast/FX model, which has been distributed to over 250 Federal users in many government agencies. The Blast/FX effects model shows the structural effect of explosives on airport facilities and projects casualties based on explosive weight and airport configuration scenarios.
- The Aviation Security R&D Program evaluated many approaches to assessing airport vulnerability and risk, and adopted one approach for use by FAA agents at airports. Development of the tool and associated training will be completed in FY99, with nationwide implementation scheduled for FY00.
- The Aviation Security R&D Program's developmental efforts resulted in a signed agreement between Sandia National Laboratories and Barringer Inc. for the production of personnel portals that detect a wide range of explosives. Sandia developed the portal under an FAA contract supported by the Aviation Security R&D Systems Development Branch. FAA anticipates the delivery of limited production models from Barringer in mid FY 2000.
- The Aviation Security R&D Program developed Threat Image Projection (TIP) systems to measure screeners' on-the-job performance.
- The Aviation Security R&D Program also developed the Computer-Assisted Passenger Pre-screening System (CAPPS) to reduce the number of passengers needing special security screening.
- The Aviation Security R&D Program developed a long-range cargo plan to evaluate new procedures and promising technologies.

R&D Partnerships

Since its inception, the Aviation Security R&D Program has fostered the establishment of productive relationships with many organizations. These organizations include U.S. government agencies, industry, academia, and foreign countries that promote technology development for improved aviation security. Each of the FAA's

cooperating organizations contributes to the Aviation Security R&D mission by providing information, R&D, equipment, and/or facilities. The FAA uses these partnership agreements to leverage its Aviation Security R&D project investments. Recent projects in partnership include:

- Bilateral agreements with the United Kingdom, France, Canada and Israel for exchange of information, development of new explosives detection technologies, and cooperation on joint ventures as well as test and evaluation.
- Cost sharing agreements with manufacturers continue to develop additional sources for certified EDS. Systems, expected to come to market in FY 99, will increase the efficiency and effectiveness of available detection options while reducing cost through competition.
- A cost sharing agreement with Alaska Airlines and with Northwest Airlines to identify and develop methods utilizing advanced technologies to improve screener performance. A third cost sharing agreement with Delta Airlines is pending.
- In support of the aircraft hardening program, expertise from the U.S. Air Force, Army and Navy, as well as NASA and Department of Energy, to develop and test hardened LD-3 containers for wide body aircraft as well as cooperation with several airlines for the operational evaluation of prototypes.
- A partnership, through another government organization and a foreign government, to investigate the practicality of developing hardened containers for use on narrow body aircraft.
- A cooperative agreement with the State of Illinois on the Security of Cargo Shipments.

Long-Range View

The FAA envisions an integrated aviation security system for the 21st century that incorporates the strengths of a variety of technologies that are continuously monitored and upgraded to respond to changes in the threat environment. This integrated system will enable aviation security professionals to perform at maximum levels of effectiveness. The application of automated detection

technologies will enhance screener performance by providing detection that is constantly vigilant and impervious to distraction or fatigue as in the case of human or canine screeners. This understanding of the aviation security system of the future provides guidance and direction for future Aviation Security R&D Program efforts and supports decisions affecting FAA investments.

Terrorist capabilities and techniques will continue to increase and evolve. This ever-changing threat

necessitates continued security R&D funding for the foreseeable future. Aviation Security R&D Program efforts will continue to focus on modifications and other technical improvements to deployed explosives detection equipment. Identification and evaluation of explosives mitigation techniques will also continue. The focus of effort will continue to expand to include the entire aviation spectrum, including airports, airplanes, and other areas of the National Airspace System.

A07a Explosives and Weapons Detection

GOALS:

Intended Outcomes: The Explosives and Weapons Detection program strives to accelerate development and application of advanced technology to eliminate the ability of terrorists to conceal improvised explosives devices, weapons, and flammable gas or liquid explosives on aircraft. Its efforts directly support the security mission in the FAA Strategic Plan.

The program fosters the developments of improved Explosives Detection Systems (EDS) and Devices (EDD) and makes them available to the airlines and groups responsible for domestic and international airline security. Specifically this program:

- Provides automated security systems capable of processing today's increasing air travel demands at minimal cost to participating facilities.
- Enhances the security of the worldwide flying public.
- Promotes adaptation of the best existing and emerging U.S. technologies in response to continually evolving threat possibilities.

Agency Outputs: The FAA publishes directives and rules detailing how the airlines must comply with national security policies. This rulemaking process depends upon research and development, testing and evaluation, and the creation of data packages in support of equipment mandates. The program's continuous involvement in present and future threat detection, and its resulting outputs, effectively enhance the security of the flying public.

The FAA has deployed both Bulk and Trace explosives detection systems through the Security Equipment Integrated Product Team (SEIPT).

Customer/Stakeholder Involvement: The FAA is the world leader in developing explosive detection research, and in testing and evaluating related equipment. Through this program, the FAA:

- Interacts with industry, academia, other government agencies, oversight groups, special interest groups, Congress, foreign governments, national laboratories, individual re-

searchers and the general public to solve their common problems.

- Sponsors respected special interest groups, including the National Academy of Science and the Committee on Civil Aviation Security of the National Research Council (NRC), to assess security research initiatives and to review explosives detection research priorities. [The NRC committee meets several times a year for its panels to address specific crucial topics such as personnel screening and the configuration management of explosives detection hardware and software. Their findings and recommendations directly affect the program's strategy and concepts.]
- Responds to congressional mandates such as P.L. 101-604, the Aviation Improvement Act of 1990, the White House Commission on Aviation Safety and Security, the Aviation Security Advisory Committee Baseline Working Group, the General Accounting Office (GAO), and section 303 of the Federal Aviation Administration Reauthorization Act of 1997.

Accomplishments: Explosives detection research results are provided to the Office of Civil Aviation Security to aid in the rulemaking process. Since 1991, the program has:

- Identified new potential threats of mass destruction and characterized them as to detectability.
- Identified contamination levels on/in luggage and on people associated with certain explosives.
- Evaluated multiple explosives trace detection systems for deployment.
- Developed and certified the world's first competitive EDS: Invision CTX.
- Certified a moderate throughput EDS with advanced user interface: Invision CTX 5500.
- Developed and certified two high throughput EDSs: Invision CTX 9000 and L-3 Examiner.
- Developed prototype Nuclear Quadrupole Resonance (NQR) simulants.

- Developed a complete suite of inert, non-toxic x-ray of simulant explosives (secondaries) for various agencies.
- Established test and evaluation criteria and protocols for checked baggage, checkpoint and cargo.
- Developed a worldwide accepted trace detection standard for electronic items.
- Held two international symposia on explosives detection.
- Sponsored three International Society for Optical Engineering (SPIE) conferences on domestic and international explosives detection.
- Conducted an International Civil Aviation Organization (ICAO) workshop on trace detection standards for electronics explosives detection.
- Completed an airport demonstration of certified explosives detection equipment at San Francisco and Atlanta international airports.
- Supported the 1996 Olympic games with explosives detection equipment installations at five airports.
- Developed competing technologies to the certified EDS.
- Developed and tested personnel portal scanning prototypes.
- Provided support to the SEIPT for airport deployment of bulk and trace detection equipment.
- Tested carry-on baggage screening with the operator assist function.

R&D Partnerships: The explosives detection program works closely with academia, industry, and other national laboratories. Partnerships with organizations reduce costs, where possible, by combining research initiatives that use the same technologies for slightly different purposes. More than ninety contracts, grants, CRDAs, and inter-agency agreements are in place with industry, academia and other government agencies. R&D partnership activities include:

- Joint funding agreements, cooperative research and development agreements, and consultation agreements through which Industry and the FAA collaborate to improve existing

and develop new carry-on, checked, and cargo scanning systems.

- Over a dozen projects supported through interagency working relationships, such as with DOE laboratories, DOD facilities, U.S. Department of Agriculture (USDA), Office of the Secretary of the Treasury (OST), U.S. Customs, and Volpe Transportation Systems Center.
- Bilateral agreements between the FAA and several international counterparts.
- Work with the Interagency Technical Support Working Group—a body that supports explosive detection projects that can be applied to other agencies; these include document scanners, cargo screening systems, miniaturization, and performance improvement of trace detection technologies and industry collaboration with foreign governments' technology development.
- Work with the NRC Committee on Commercial Aviation Security—a body that regularly reviews the explosives/weapons detection program and makes recommendations supporting further developments.

MAJOR ACTIVITIES AND ANTICIPATED FY 2000 ACCOMPLISHMENTS:

Checked Baggage Screening Technology.

- Reduced false alarm rate in fielded EDS systems.
- Performed R&D to enhance performance of explosives detection canines.
- Developed requirements and explored low cost EDS for small airports.
- Certified a lower cost, lower throughput EDS.
- Developed directed trace screening protocol.

Checkpoint Technology.

- Developed explosive standards for luggage and personnel.
- T&E of trace personnel devices to augment checkpoint security.
- Developed at least three checkpoint research centers/test beds.
- Developed an automated carry-on prototype.

- Developed trace detection standards for personnel screening.
- Designed and tested at least two advanced, integrated checkpoint system designs.
- Developed a fast holographic passenger screening prototype.
- Tested at least one ticket and/or token trace scanner.
- Developed NQR wand prototype.

Cargo Security Technology.

- Completed evaluation of commercially available screening systems for containerized/palletized cargo.
- Determined feasibility of using trace for cargo screening.
- Developed automated cargo profiling system.
- Developed training protocols for manual search of cargo.

KEY FY 2001 PRODUCTS AND MILESTONES:

Checked Baggage Screening Technology.

- Evaluate coherent scattering system.
- Develop and certify low cost throughput EDS.
- Develop prototype trace based automated EDS.

Checkpoint Technology.

- Optimize performance of NQR for luggage.
- Explore advanced bottle scanners.
- Enhance/develop systems to handle emerging threats.
- Enhance/develop and test combined technology personnel inspection system utilizing bulk and trace technologies.
- Develop and test NQR wand system for passengers and bags.

Cargo Security Technology.

- Complete evaluation of EDS technology for screening break bulk cargo.
- Complete guidelines for matching EDS technologies to cargo types.
- Complete training protocols for manual search of cargo.
- Complete threat assessment between cargo and other vectors.
- Develop guidelines for matching EDS technologies to cargo types.
- Complete training protocols for non-intrusive screening of cargo.

FY 2001 PROGRAM REQUEST:

The program develops or enhances technologies that detect or discover emerging threats in both the trace and bulk detection areas. Capabilities are added to existing or new systems to handle threats not addressed by current technologies. In each case, standards are developed to characterize the performance of the newly developed system capabilities.

Combined technologies are used that merge a system's ability to analyze and integrate data from multiple sensors, thus providing an improved detection over single system capability. This applies to baggage, cargo, and personnel scanning devices. The results of this research should increase the probability of detection and decrease the false alarm rates over existing technologies performing similar individual functions. New combinations of devices are being considered for use in environments inaccessible to public view.

Research continues into the development of faster, more automated, and cheaper systems, which could more easily be integrated into an airport environment. The program makes maximum use of data and experience gained from deploying existing equipment.

2000 FAA NATIONAL AVIATION RESEARCH PLAN

A07a - Explosives and Weapons Detection Product and Activities	FY 2001 Request (\$000)	Program Schedule					
		FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY2005
071-110 Explosives/Weapons Detection							
Checked Baggage Screening Technology	\$15,290						
Developed Detonator Detection Technology		◆					
Develop Low-Cost Explosives Detection System (EDS) for Low Throughput Stations		◆	◇	◇			
Develop High Throughput EDS for 100% Screening		◆	◇	◇	◇	◇	◇
Performance Improvement of Deployed Systems	\$2,000						
Reduce False Alarms		◆	◇				
Integrate Alternative Technologies		◆	◇	◇	◇		
Develop Trace-Based EDS		◆	◇	◇	◇		
Develop Integrated Multi-Technology EDS	\$2,500						
Certify EDS Upgrades		◆	◇	◇	◇	◇	◇
Test and Evaluation		◆	◇	◇	◇	◇	◇
Develop Fast, Non-Invasive Passenger Screening Systems:	\$6,250						
Develop and Test Trace Portals		◆	◇	◇	◇	◇	
Develop and Test Low-Cost Passenger Portals				◇	◇	◇	◇
Develop and Test Fast, Hand-Held Explosive Detection Wands				◇	◇	◇	◇
Develop and Test Ticket Trace Scanners		◆	◇	◇	◇	◇	
Develop Automated Carry-On Baggage Inspection Systems:	\$500						
Develop and Test Fast, Integrated Bottle Contents Scanners		◆	◇	◇			
Design and Test Optimized, Integrated Checkpoint Systems					◇	◇	◇
Develop Checkpoint Research Centers and Testbeds		◆	◇	◇	◇	◇	◇
Cargo Security Technology	\$5,400						
Develop Automated Cargo-Profiling System		◆	◇				
Operational Evaluation of Automated Cargo Profiling System			◇				
Develop Guidelines for Matching EDS Technologies to Cargo Types			◇				
Complete Threat Assessment between Cargo and Other Vectors		◆	◇				
Develop Contingency Plans for Enhanced Cargo Threat			◇		◇		
Complete Ground Transit Security Study		◆	◇				
Develop Training Protocols for Manual Search of Cargo		◆					
Develop Training Protocols for Screening of Cargo		◆	◇				
Evaluate Containerized/Palletized Inspection Systems		◆					
Develop Advanced Screening Technologies for Cargo		◆	◇	◇			
Evaluate Trace and Bulk Explosives Detection Technology		◆	◇				
Enhance Cargo Security Demonstration Project				◇	◇	◇	◇
Personnel and Other Costs	\$5,520						
Total Budget Authority	\$37,460	\$37,605	\$37,460	\$38,019	\$38,798	\$39,812	\$41,081

Note: Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.

Budget Authority (\$ in Thousands)	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request
Contracts	38,629	30,832	37,696	32,299	31,940
Personnel Costs	2,297	2,796	3,462	4,827	4,682
Other Costs	471	572	542	479	838
Total	41,397	34,200	41,700	37,605	37,460

A07b Airport Security Technology Integration

GOALS:

Intended Outcomes: This program supports the security mission in the FAA Strategic Plan and it addresses specific aviation security vulnerabilities and reduction of international security incidents through cooperation with foreign governments. The program strives to block terrorist access to the aircraft through analysis of airport vulnerabilities, investigation of advanced perimeter control surveillance systems, and development of systems that provide for strict accountability for luggage loaded onto an aircraft.

Additionally, the program supports other aviation security programs by:

- Identifying advanced threats that the aviation community may face in the near future.
- Developing sophisticated models to predict the operational effects of inserting security measures into the existing aviation system.
- Evaluating security devices in terms of operational suitability and supplementing the development of reliable equipment.

Overall progress on meeting these goals results from: (1) providing methods to objectively analyze impacts on passenger flow and costs associated with security risk mitigation; (2) identifying and developing new technologies, methodologies, and procedures to enhance the performance of security professionals in the performance of their aviation security mission; and (3) developing and maintaining an integrated security system approach for countermeasures to the identified threats of the civil aviation system.

Agency Outputs: The FAA establishes the regulations governing airport and airline security and the rules for security inspections. The FAA publishes these rules and regulations, with guidance for their implementation, in the form of advisory circulars (AC). The airport security technology integration program also provides reports and analyses of technical information (such as airport vulnerability assessments) to aid the civil aviation security community in improving security methods.

Customer/Stakeholder Involvement: The FAA develops an extensive collaboration within the

domestic and international aviation security communities. The R,E&D efforts include industry participation with the Air Transport Association (ATA) to study the operational costs and effects of positive passenger baggage matching (PPBM). This effort is designed to prevent the loading of unaccompanied baggage on aircraft. The FAA collaborates with the Societe Internationale De Telecommunications Aeronautiques (SITA) and the International Air Transport Association (IATA) in the development of standards for baggage tracking and reconciliation systems and tagging technologies. Collaboration with the Airport Consultants Council and most other major airport organizations is needed for development and revision of the Security Considerations for Airport Construction Guidelines.

The program responds to Public Law 101-604, the Aviation Security Act of 1990, the Aviation Security Advisory Committee (ASAC) recommendations, and the recommendations of the White House Commission on Aviation Safety and Security. These pieces of legislation provide impetus for security research requirements and dissemination of the research results to industry.

Accomplishments: Results of the airport security technology integration program are provided to the aviation community for their use, and to the Office of Civil Aviation Security, as follows, to assist them in the rulemaking process:

- Completed assessments of radio frequency (RF) technology for PPBM.
- Completed evaluations of commercial off-the-shelf (COTS) airport vulnerability assessment tools against developed functional requirements.
- Identified and refined a vulnerability/risk assessment method for use by FAA agents nationwide.
- Provided statistical analysis of findings to industry.
- Integrated security vulnerability countermeasures into operational test beds to validate security benefits and operational suitability.
- Completed bi-annual technical reports, which identify and prioritize advanced technical

threats against civil aviation. These reports drive research requirements and guide current and future research trends.

- Completed an airport explosives security survey analysis and correlated information to identify vulnerabilities across 76 domestic airports. Information was provided back to airports on areas of concern and corrective action.
- Published guidelines for industry on security revolving doors for use at concourse screening points.
- Published functional guidelines for a PPBM system.
- Developed an automated tool to assess facility and personnel damage from blast effects, and to estimate and evaluate the effectiveness of blast mitigation measures.
- Performed study on feasibility of detecting unauthorized personnel access based on existing ground surveillance radar.
- Investigated advanced airport security command and control methods.
- Identified opportunities for airport security and operations improvements using information integration.

R&D Partnerships: Through partnership with the RTCA Subcommittee (SC) 183 and participation of industry, developed a standard for airport security access control systems. Relationships with ATA and the Regional Aircarrier Association (RAA) focus on the study of economic effects of PPBM on the industry. A year long cooperative study culminated with the publication of a project report that analyzes the economic effects of PPBM on the aviation industry. The FAA continues this relationship to fulfill the requirements of the White House Commission on Aviation Safety and Security recommendations for PPBM. The Airport Security Technology Integration (ASTI) program determines the operational effects of alternative approaches to, and research of, technologies to increase the efficiency and security of reconciling baggage with passengers.

The program works with Airports Council International-North America (ACI-NA) to integrate

operational airport design needs into a passenger baggage flow model (PBFM) tool. Upon completion, this software package will be transferred to industry for use as a tool in configuring security systems and technologies into the airport environment.

The program and the State of Illinois have cosponsored research on the security of cargo shipments in transit from the remote cargo facilities to the airlines' receiving points. Testing has determined the feasibility of a positive driver identification and cargo seal system. This project received national recognition as the leading innovative usage of technology.

The program has completed interagency agreements with the Department of Defense Office of Special Technology to coordinate technology assessments. Also, the agency coordinates efforts with the U.S. Air Force and the DOD Defense Special Weapons Agency on the simulation and modeling of blast effects and biological and chemical effects on aviation facilities. With the Technical Support Working Group, the program is represented on the Executive Oversight Committee for development of Automated Tools for Vulnerability Assessment.

The ASTI program has lead the FAA's Airport Vulnerability Assessment effort. The resulting process has been accepted by the airport community as a result of the continuous involvement of the American Association of Airport Executives (AAAE), ACI-NA and the Airport Law Enforcement Agency Network (ALEAN).

Relationship with the National Center for Biometrics Testing at San Jose State University has brought valuable expertise to security projects involving positive human identity verification through the use of biometric devices (such as fingerprint, hand geometry, etc.).

Additionally, grants, cooperative research and development agreements (CRDA), and memorandums of understanding/agreement with industry, academia, and other government agencies provide leverage to the program in areas of mutual interest.

**MAJOR ACTIVITIES AND ANTICIPATED
FY 2000 ACCOMPLISHMENTS:**

Domestic Air Travel

- Transferred assessments of RF technology for baggage tracking or PPBM to industry.
- Developed a protocol standard for explosives detection systems to communicate with baggage handling systems to ensure accurate tracking of alarmed bags.
- Completed a PBFM.
- Incorporated enhancements to blast effects model.
- Developed toxic effects model.

Airport Security

- Selected airport vulnerability assessment tools and methods, and developed an internal FAA capability for airport assessment.
- Revised and updated Airport Security Construction Guidelines.
- Established a reliability engineering program to influence and supplement security sensor development.
- Planned and conducted airport operational suitability tests on development-proven equipment.
- Refined the threat/countermeasures database.
- Developed an architecture for security monitoring equipment information integration.
- Researched advanced countermeasures.
- Developed operational test bed infrastructure at selected airports and the Technical Center's security operations center.

KEY FY 2001 PRODUCTS AND MILESTONES:

Domestic Air Travel

- Publish a threat analysis report for advanced threats to civil aviation security.

- Publish results of applications of the PBFM and the explosive blast model.

Airport Security

- Continuously evaluate EDS and other security vulnerability countermeasures in operational test beds.
- Refine airport vulnerability assessment methods used by field personnel.
- Maintain an evaluation scorecard for all security sensor development projects focused on assessing the operational suitability of these devices.
- Develop reliability and maintainability programs to supplement the performance oriented sensor development projects.
- Test emerging sensors and systems for low-cost performance intrusion detection.

FY 2001 PROGRAM REQUEST:

In FY 2000, the program is evolving toward a focus on operational suitability and systems engineering. The FY 2001 period will carry forward the operational emphasis with selected equipment operational evaluations in test-bed airports. This activity specifically supports the equipment transition activities of the Security Equipment Integrated Product Team (SEIPT), and will benefit from the lessons learned by field experience gained on SEIPT installed security equipment. The emphasis on systems engineering results in supplemental analyses and field evaluations of operational issues, equipment availability, reliability and maintainability. The end result is that equipment that completes the development cycle will not only achieve the required performance levels but will also be fully operationally suitable.

2000 FAA NATIONAL AVIATION RESEARCH PLAN

A07b - Airport Security Technology Integration Product and Activities	FY 2001 Request (\$000)	Program Schedule					
		FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
<i>073-110 Airport Security Technology Integration</i>							
Domestic Air Travel	\$20						
Transferred Assessments of Radio Frequency (RF) Technology for Baggage Tracking or Positive Passenger Bag Match (PPBM) to Industry		◆					
Publish Threat Analysis Report for Advanced Threats to Civil Aviation Security			◇				
Developed a Protocol Standard for Explosives Detection Systems (EDS) to Communicate with Baggage Handling Systems to Ensure Accurate Tracking of Alarmed Bags		◆					
Completed Passenger and Baggage Flow Model		◆					
Incorporated Enhancements to Blast Effects Model		◆					
Publish Results of Applications of the Passenger Baggage Flow Model and the Explosive Blast Model			◇				
Developed Toxic Effects Model		◆					
Airport Security	\$855						
Continuously Evaluate EDS & Other Security Vulnerability Countermeasures in Operational Testbeds			◇	◇	◇	◇	◇
Selected Airport Vulnerability Assessment Tools and Methods		◆					
Developed Internal FAA Capability for Airport Assessment		◆					
Revised and Updated Airport Security Construction Guidelines		◆					
Established a Reliability-Engineering Program to Influence and Supplement Security Sensor Development		◆					
Develop Reliability and Maintainability Programs to Supplement the Performance Oriented Sensor Development Projects			◇	◇	◇		
Plan and Conduct Airport Operational Suitability Tests on Development-Proven Equipment		◆	◇	◇	◇	◇	◇
Refine Threat/Countermeasures Data Base		◆	◇	◇			
Developed an Architecture for Security Monitoring Equipment Information Integration		◆					
Refine Airport Vulnerability Assessment Methods to Be Used by Field Personnel			◇		◇		◇
Maintain an Evaluation Scorecard for all Security Sensor Development Projects Focused on Assessing the Operational Suitability of these Devices			◇	◇	◇	◇	
Researched Advanced Countermeasures		◆					
Test Emerging Sensors and Systems for Low-Cost Performance Intrusion Detection			◇	◇	◇	◇	◇
Developed/Refined Operational Testbed Infrastructure at Selected Airports and Technical Center's Security Operations Center		◆					
Personnel and Other Costs	\$1,587						
Total Budget Authority	\$2,462	\$2,285	\$2,462	\$2,555	\$2,568	\$2,772	\$2,898

Note: Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.

Budget Authority (\$ in Thousands)	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request
Contracts	3,165	1,127	1,832	909	875
Personnel Costs	492	1,127	754	1,258	1,435
Other Costs	101	231	122	118	152
Total	3,758	2,485	2,708	2,285	2,462

A07c Aviation Security Human Factors

GOALS:

Intended Outcomes: The Aviation Security Human Factors program supports the FAA's Strategic Plan security goal to improve the detection of explosives and weapons within the NAS. Specifically, the program focuses its efforts upon establishing the baseline level of security and addressing related vulnerabilities.

This program leverages funding for equipment development to improve aviation security system performance through the following means:

- Optimize human performance contributions through better operator selection, training, and performance monitoring for the various detection technologies.
- Create better security machine interfaces and integration by merging individual detection systems into a combined technology system with optimized human performance contributions.

Agency Outputs: The FAA establishes standards for security activities and this program conducts R&D for technical input essential to:

- Reduce security costs as a result of automation.
- Reduce vulnerability to terrorist threats.
- Decrease risk of catastrophic financial loss resulting from sabotage of an airplane.
- Increase public confidence in the safety of air travel.
- Increase global U.S. industrial competitiveness.
- Improve security screener certification.

Customer/Stakeholder Involvement: The Aviation Security Human Factors program:

- Supports the Office of the Associate Administrator for Civil Aviation Security as mandated by the Aviation Security Improvement Act of 1990 (PL 101-604).
- Responds to requirements from the Aviation Improvement Act of 1990, the White House Commission on Aviation Safety and Security, Baseline Working Group on Aviation Security, and the General Accounting Office (GAO).

- Partners with multiple airlines to test and evaluate equipment, personnel and procedures.

Accomplishments: The following results of Aviation Security Human Factors research were provided to the Office of Civil Aviation Security to assist them in the rulemaking process:

- Refined the definition of knowledge, skills, and abilities needed for checkpoint screening.
- Developed functional requirements for the Screener Proficiency Evaluation and Reporting System (SPEARS) components of screener selection, training, and performance monitoring.
- Measured baseline checkpoint security performance.
- Developed screener selection tests for estimating future performance and interpreting both conventional X-ray and computed tomography (CTX 5000) images.
- Developed computer based training (CBT) for both checkpoint operations and checked baggage evaluation with the CTX 5000.
- Developed threat image projection (TIP) for both conventional X-ray machines and the CTX 5000.
- Developed a duplicate checklist system.
- Developed a screener readiness test after initial training.
- Developed a computer-assisted passenger screening (CAPS) profiling system.
- Developed on-the-job completion tests.

R&D Partnerships: This program works closely with various agencies and groups, such as:

- Lawrence Livermore National Laboratory — inter-agency agreement.
- Domestic airlines and research organizations including:
 - Alaska Airlines
 - Delta Airlines
 - EG&G Astrophysics
 - Northwest Airlines
 - Public Computer Systems
 - Rapiscan Security Products

MAJOR ACTIVITIES AND ANTICIPATED FY 2000 ACCOMPLISHMENTS:

Screener selection/training/testing.

- Determined knowledge, skills, and abilities required for screeners to use emerging detection technologies.
- Improved screener selection, screener machine interfaces, CBT multimedia training, and performance monitoring systems for emerging detection technologies.
- Established criteria and data for rulemaking about screener selection, training, and proficiency assessment.
- Developed screener certification testing protocols.

Human Systems Integration (HSI).

- Completed evaluations of detection systems involving emerging technologies such as bottle screening and millimeter wave detection.
- Optimized combined detection technologies through component integration within futuristic screener stations.
- Integrated new and emerging detection technologies into the operational environment.
- Provided HSI evaluations on the manpower, personnel, training, human factors engineering, health, and safety aspects of security systems.

KEY FY 2001 PRODUCTS AND MILESTONES:

Screener selection/training/testing.

- Determine knowledge, skills, and abilities for using emerging detection technologies.
- Improve screener selection, screener machine interfaces, CBT multimedia training, and performance monitoring systems for emerging detection technologies.

- Establish criteria and data for rulemaking on screener selection, training, and proficiency assessment.
- Establish criteria and data to support rulemaking for screener certification.

Human Systems Integration (HSI).

- Continue to evaluate detection systems involving emerging technologies.
- Integrate new and emerging detection technologies into the operational environment.
- Provide HSI evaluations on the manpower, personnel, training, human factors engineering, health, and safety aspects of security systems, especially those involving EDS and weapons detection technologies.

FY 2001 PROGRAM REQUEST:

This program focuses on producing key FY 2001 products to accomplish stated goals. Results emphasize R&D within the areas of screener selection/training/testing, and human systems integration. The program improves screener selection, screener machine interfaces, CBT multimedia training, and performance monitoring systems for emerging detection technologies. This research provides the basis for establishing criteria and data for rulemaking. It evaluates detection systems involving emerging technologies such as bottle screening and millimeter wave detection. It also optimizes detection technologies through component integration within futuristic screener stations and integrates new and emerging detection technologies into the operational environment. Finally, it provides Human Systems Integration evaluations on the manpower, personnel, training, human factors engineering, health, and safety aspects of security systems, especially those involving EDS and weapons detection technologies.

2000 FAA NATIONAL AVIATION RESEARCH PLAN

A07c - Aviation Security Human Factors Product and Activities	FY 2001 Request (\$000)	Program Schedule					
		FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY2005
<i>076-110 Aviation Security Human Factors</i>							
Screener Selection/Training/Testing	\$1,955						
Determine Knowledge, Skills, and Abilities Required for Screeners to Use Emerging Technologies	◆	◇	◇	◇	◇	◇	◇
Improve Screener Selection, Screener-Machine Interfaces, CBT Multimedia Training, and Performance Monitoring Systems for Emerging Detection Technologies	◆	◇	◇	◇	◇	◇	◇
Establish Criteria and Data for Rulemaking about Screener Selection, Training and Proficiency Assessment	◆	◇	◇	◇	◇	◇	◇
Developed Screener Certification Testing Protocols	◆						
Establish Criteria and Data to Support Rulemaking for Screener Certification		◇					
Human Systems Integration (HSI)	\$2,162						
Provide HSI Evaluations on Manpower, Personnel, Training Human Factors Engineering, Health and Safety Aspects of Security Systems	◆	◇	◇	◇	◇	◇	◇
Evaluate New Detection Systems (e.g. Bottle Screening, Millimeter Wave Detection)	◆	◇	◇	◇	◇	◇	◇
Integrate New and Emerging Technologies into Operational Environment	◆	◇	◇	◇	◇	◇	◇
Optimize Combined Detection Technologies through Component Integration within Futuristic Screener Stations	◆	◇	◇	◇	◇	◇	◇
Personnel and Other Costs	\$1,028						
Total Budget Authority	\$5,145	\$5,256	\$5,145	\$5,234	\$5,354	\$5,502	\$5,685

Note: Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.

Budget Authority (\$ in Thousands)	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request
Contracts	4,446	4,723	4,078	4,114	4,117
Personnel Costs	492	679	1,064	1,032	921
Other Costs	101	138	140	110	107
Total	5,039	5,540	5,282	5,256	5,145

A07d Aircraft Hardening

GOALS:

Intended Outcomes: In accordance with the strategic goal of eliminating security incidents in the aviation system, the overriding goal of the program is to protect commercial aircraft from catastrophic structural or critical system failure due to an in-flight explosion. Secondary objectives are to investigate vulnerability from some spurious electromagnetic or high energy signal interfering with aircraft electronic systems and to assess the threat presented by manually operated, highly mobile, surface to air missiles.

The program is designed to determine and identify:

- Minimum size explosives that would result in aircraft loss.
- Methods and techniques that can be applied to the current and future fleet of commercial aircraft to decrease the level of vulnerability to explosive effects.
- Threats to aircraft from electromagnetic (EM), projected energy, and surface to air missiles and practical countermeasures.

Agency Outputs: The program is tasked with delivering documented explosive vulnerability data to the explosive detection community and, depending on research results, providing recommendations for rulemaking relative to mitigation techniques. In the area of other threats, the program provides reports to the staff of the Associate Administrator for Civil Aviation Security characterizing specific commercial aircraft vulnerability to threats as well as possible countermeasures. In order to meet these requirements, the program has been divided into the following separate projects: explosive vulnerability and aircraft design related mitigation techniques, container hardening, and protection against advanced terrorist threats.

Customer/Stakeholder Involvement: The aircraft hardening program was initiated in 1990 in response to the directives of the President's Commission on Aviation Safety and Security and the mandates set forth in the Aviation Security Improvement Act of 1990. The program is continually assessed by the Security Subcommittee of the FAA R,E&D Advisory Committee and has been subjected to scrutiny and endorsed by the General

Accounting Office. The content of the program is in direct support of the customer, the Assistant Administrator for Civil Aviation Security, and complies with the aviation security requirements document of the Office of Civil Aviation Security. Additionally, the program is required to periodically report technical progress directly to Congress.

Accomplishments: The Aircraft Hardening program has:

- Validated current detection standards through analysis and explosive testing of the minimum size, type, and location of explosives, which could result in catastrophic aircraft failure.
- Proved the feasibility of and determined the standards for explosive resistant luggage containers used in wide body aircraft.

As a continuation to the container effort, which was suggested by various members of Congress:

- Provided prototype containers to the airlines to complete an operational assessment of the cost and improved security effectiveness of implementing hardened containers.
- While working with the Department of Defense and other government agencies:
- Developed a process to assess the vulnerability of commercial aircraft to terrorist induced electronic and mobile missile threats.

R&D Partnerships: From the onset, the program has used expertise from the U.S. Air Force, U.S. Army, and U.S. Navy as well as consulted with various Department of Energy laboratories and NASA. Relationships also have been established with the U.S. aircraft and container manufacturing industries and research efforts have been coordinated with the United Kingdom, Israel and France. The program uses the services of many defense and aircraft related industries. The prime program objective is the collection of data in support of rulemaking. As the program utilizes a wide spectrum of industry experts, all developed technologies have been or will be directly transferred to the appropriate private market.

**MAJOR ACTIVITIES AND ANTICIPATED
FY 2000 ACCOMPLISHMENTS:**

Container hardening.

- Transitioned container technologies to private industry.
- Completed operational assessment of LD-3 hardened containers with airlines.
- Developed and tested protective luggage units for use on narrow body aircraft.

Aircraft vulnerability.

- Validated, through explosive testing, the blast effects of a variety of different explosives for the purpose of refining detection criteria.
- Assessed the practicality of protecting overhead compartments from explosive effects.

Projected energy, electromagnetic, and other terrorist threats.

- Identified possible mitigation techniques to counter projected energy and other threats.
- Developed procedures/rules for Man Portable Air Defense Systems (MANPADS).

**KEY FY 2001 PRODUCTS AND MILE-
STONES:**

Container hardening.

- Determine operational impacts of hardened baggage units on narrow body aircraft.
- Complete assessment of other than LD-3 size containers; make the decision on rulemaking.

Aircraft vulnerability.

- Assess security implications associated with the introduction of 800-1000 passenger jets.

- Validate appropriate new techniques including hardening of overhead compartments to mitigate explosive effects.

- Develop new aircraft certification criteria.

Projected energy, electromagnetic, and other terrorist threats.

- Develop procedures/rules for electromagnetic interface.
- Work with Department of Defense in assessing practicality of technical solutions to counter the man portable air defense systems.

FY 2001 PROGRAM REQUEST:

In FY 2001, the program continues to focus on the areas listed at the beginning of the GOALS section above. As the vulnerability assessments evolve, ideas to mitigate blast either through retrofitting the current fleet or instituting new design techniques and materials are being identified. These ideas and concepts are analyzed and tested and recommendations for new specifications are made as required. Special emphasis is placed on assessing and recommending hardening actions regarding the long-term implications of terrorism on new commercial aircraft concepts such as the 800 to 1000 passenger jumbo jets. In addition, analyses of the impact of EM, Projected Energy (PE), and MANPADS on commercial aircraft are underway and anticipated to be complete by the end of FY 2001. These research efforts are primarily investigative in nature and involve an assessment of the potential vulnerability of an aircraft to these threats.

2000 FAA NATIONAL AVIATION RESEARCH PLAN

A07d - Aircraft Hardening Product and Activities	FY 2001 Request (\$000)	Program Schedule					
		FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY2005
075-110 Aircraft Hardening	\$2,112						
Container Hardening							
Completed Operational Assessment of LD-3 Hardened Containers with Airlines		◆					
Complete Assessment of Other Than LD-3 Size Containers, Make Decision on Rulemaking			◇	◇			
Developed and Tested Protective Luggage Units for Use on Narrow Body Aircraft		◆					
Determine Operational Impacts of Hardened Baggage Units on Narrow Body Aircraft			◇	◇			
Develop rules for Narrow Body Protective Units			◇	◇	◇	◇	
Transition Container Technologies to Private Industry		◆	◇	◇	◇	◇	
Aircraft Vulnerability	\$1,038						
Validated Through Explosive Testing, the Blast Effects of a Variety of Different Explosives for the Purpose of Refining Detection Criteria		◆					
Assessed the Practicality of Protecting Overhead Compartments from Explosive Effects		◆					
Assess Security Implications Associated with the Introduction of 800 - 1,000 Passenger Jets			◇				
Validate Appropriate New Techniques Including Hardening of Overhead Compartments to Mitigate Explosive Effects			◇	◇			
Develop New Aircraft Certification Criteria			◇	◇	◇	◇	◇
Projected Energy/Electromagnetics/Other Terrorists Threats	\$275						
Identified Possible Mitigation Techniques to Counter Projected Energy and Other Threats		◆					
Developed Procedures/ Rules For Man Portable Air Defense Systems (MANPADS)		◆					
Develop Procedures/Rules for Electromagnetic Interface			◇				
Develop Procedures/Rules for Projected Energy			◇	◇			
Work with DoD in Assessing Practicality of Technical Solutions to Counter MANPADS			◇				
Publish Reports Identifying Cost-Effective Alternatives for Mitigating The Threat Of Electromagnetic, Projected-Energy Weapons and MANPADS			◇	◇	◇		
Assess Aircraft Design Implications Relative to Chemical/ Biological Threats			◇	◇	◇	◇	
Develop Procedures/Rules for Chemical/Biological Threat			◇	◇	◇	◇	◇
Personnel and Other Costs	\$882						
Total Budget Authority	\$4,307	\$5,001	\$4,307	\$4,383	\$4,482	\$4,609	\$4,764

Note: Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.

Budget Authority (\$ in Thousands)	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Request
Contracts	6,268	1,393	1,139	3,371	3,425
Personnel Costs	492	504	754	1,497	801
Other Costs	101	103	107	133	81
Total	6,861	2,000	2,000	5,001	4,307

This page intentionally left blank.